Past and projected future climate impacts to coral reefs in the the United States

**Note on emissions scenarios:**

The emissions scenarios used by the Intergovernmental Panel on Climate Change (IPCC) are called Representative Concentration Pathways. RCP8.5 reflects business-as-usual, i.e., that climate policy will have little to no affect on the growth of greenhouse gas concentrations in the atmosphere between now and 2100. We are currently tracking above what RCP8.5 suggested would be the CO₂ concentration (at the Mauan Lea observation site in Hawaii) in 2017. RCP4.5 is a stabilization scenario that assumes emissions modestly reduce on this century, decades and stabilize later in the century. Greenhouse gas concentrations in 2050 under RCP4.5 represent 1.5 times the reductions in emissions pledged under the recently ratified Paris Agreement. Recent emissions reductions pledges are not enough for RCP4.5 to represent our future; however, these recent pledges may result in great momentum in our efforts to reduce emissions. We can compare RCP8.5 and RCP4.5 to examine the effects of our efforts to reduce emissions on coral reef futures.

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**Past**

- Coral bleaching in American Samoa. Images © XL Catlin Seaview Survey.
- **Rate at which temperatures increased between 1982 and 2012:** This is the trend in annual temperatures, or the change in temperatures when expressed as annual averages.

- **Change in aragonite saturation (Ωarag) 2006 to 2050 under RCP8.5:**

- **Projected sea level rise (m) under RCP8.5 between 2006 and 2100:**

- **Projected timing of the onset of annual severe bleaching under RCP8.5:** At this point in time, the current generation of climate models suggest that thermal stress severe enough to cause bleaching will occur every year.

- **Projected timing of the onset of annual severe bleaching under RCP4.5:**

- **Difference between onset of ASB under RCP8.5 and RCP4.5:**

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**Projected Future**

- **Percentage of coral cover in various areas:**

- **Number of events ≥ 4 DHW:**

- **Number of events ≥ 8 DHW:**

- **Difference in years between RCP8.5 and RCP4.5 in the timing of annual severe bleaching:**

- **Sea level rise under RCP8.5 (m):**

- **Change in aragonite saturation (Ωarag) 2006 to 2050 under RCP4.5:**

- **Coral calcification could decline 15% for each unit of Ωarag declined.** This number is an estimate from a meta-analysis of 25 studies presented in Chan & Connolly (2013). Small changes in calcification could mean that a coral bleached from one study could be calcifying more than another bleached coral under some factors. The loss of CaCO₃ due to physical and biological erosion (Glynn, 1997) remains an important factor determining how acidification affects calcification rates. Changes in aragonite saturation rates are projected to be lower in the Caribbean than the Pacific, where oceanic Guarian than other parts of the Pacific.

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These data and maps are adapted from these publications:

- Glynn, P. W. (1997). Bioerosion and Coral Reef Growth: A Dynamic Balance. In: CLIMATE CHANGE (IPCC) are called Representative Concentration Pathways. RCP8.5 reflects business-as-usual, i.e., that climate policy will have little to no affect on the growth of greenhouse gas concentrations in the atmosphere between now and 2100. We are currently tracking above what RCP8.5 suggested would be the CO₂ concentration (at the Mauan Lea observation site in Hawaii) in 2017. RCP4.5 is a stabilization scenario that assumes emissions modestly reduce on this century, decades and stabilize later in the century. Greenhouse gas concentrations in 2050 under RCP4.5 represent 1.5 times the reductions in emissions pledged under the recently ratified Paris Agreement. Recent emissions reductions pledges are not enough for RCP4.5 to represent our future; however, these recent pledges may result in great momentum in our efforts to reduce emissions. We can compare RCP8.5 and RCP4.5 to examine the effects of our efforts to reduce emissions on coral reef futures.

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**References (cited):**